PROGRESS REPORTS
FROM
EXPERIMENT STATIONS

SEASON 1953-54

TANGANYIKA TERRITORY
LAKE PROVINCE

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TANGANYIKA TERRITORY
LAKE PROVINCE

PROGRESS REPORT FOR THE SEASON 1953-54

BY

J. E. PEAT, J. M. MUNRO AND M. H. ARNOLD.

COTTON SEASON.

Planting: Ukiriguru, 1st December 1953 to mid January 1954.
Lubaga, November 1953 to January 1954.
Cultivators, mainly November 1953 to January 1954.

Picking: Mid April until August.

Legal uprooting date: 15th September 1954.

Rainfall for the period 1st October 1953 to 30th June 1954.
Ukiriguru: 24·34 inches. (March 0·15 ins.)
Lubaga: 25·89 inches. (March 3·73 ins.)

INTRODUCTION.

Ukiriguru Station.

Meteorology.—At Ukiriguru the dominating feature of the season was the dry March; all results have to be reviewed in the light of this. Early rains were good, but there was a dry spell of nearly four weeks in late January/February. This was broken by just over 2 inches in late February, but only 0·15 ins. fell in March. April/May rains were very good indeed, but there was not then time to make a new plant and allow cropping recovery before the dry season winds started early in June.

It is only the second time, in the 23 years that records have been kept at Ukiriguru, that there has been a March drought. Dry periods in January/February are more frequent, but these affect the cotton crop at an earlier stage; they are less harmful and there can be cropping recovery.

Some areas had showers in March, and therefore did not suffer as much as Ukiriguru. Lubaga had just under 26 inches for the period 1st October 1953 to 30th June 1954, of which 3·73 inches fell in March.

Staff.—Mr. M. H. Arnold was on vacation leave from 2nd April 1954 to 16th July 1954.

Mr. J. M. Munro was on vacation leave from 6th July 1954 to 15th November 1954.

Mr. H. Doggett continued at Ukiriguru as Botanist of the Department of Agriculture.

Mr. R. A. Brown, Field Officer (Agriculture) as Farm Manager, and Mr. A. D. P. Angelini, Junior Field Officer, continued their excellent work throughout the season.

Mr. I. S. Mkwawa, Assistant Agricultural Officer, went on vacation leave on 5th July 1954, and at the end of his leave was transferred to Tengeru.

Visitors.—During the season Ukiriguru was visited by, amongst others, His Excellency the Governor, Sir Edward Twining; the Chairman of the Corporation and Mrs. Littlewood; Dr. Toy and Mr. and Mrs. Underwood, of the Shirley Institute, Manchester; the United Nations Visiting Mission to Tanganyika; and Mr. D. Rhind and Sir Geoffrey Clay of the Colonial Office.

In May 1954 the East Africa High Commission Specialist Committee on Agricultural Botany held at Ukiriguru its third meeting; seven visiting members and six visiting observers attended.

Show.—A Station exhibition staged at the Sukumaland Show, held in July 1954 at Ngudu in the Lake Province, was awarded the Sukumaland Show Committee Challenge Trophy for the best departmental demonstration and exhibit.

Lake Province Cotton.

The 1953-54 production, over 91,000 bales, is far and away the record for the Lake Province—and it is reported that in addition there was crop loss by heavy late rains, and that much Grade B seed cotton was left unpicked or not sold. Had the March showers been more widespread the Provincial crop should have been even larger. The acreage planted to cotton was reported (Regional Assistant Director of Agriculture, Mwanza) as just over 216,000 acres, 30% greater than the acreage reported for the 1951-52 season, when the previous record of 71,000 bales was attained.

Using the official records of acreage, Fig. 1 shows the yields since 1930 in bales of lint per hundred acres. There has been a significant increase in yield per acre since 1941, when the average was around 22 bales per hundred acres—just about half the present average. Part of this can fairly be claimed for the increased yield from the Ukiriguru seed issues, and part as a result of extension activities towards timely planting and better husbandry. Due regard, however, has to be given to the effects of development in the higher yielding lake shore areas, e.g., Geita district.

Given the existing seed stocks and present standards of husbandry, the most important factor in production is the acreage timely planted.

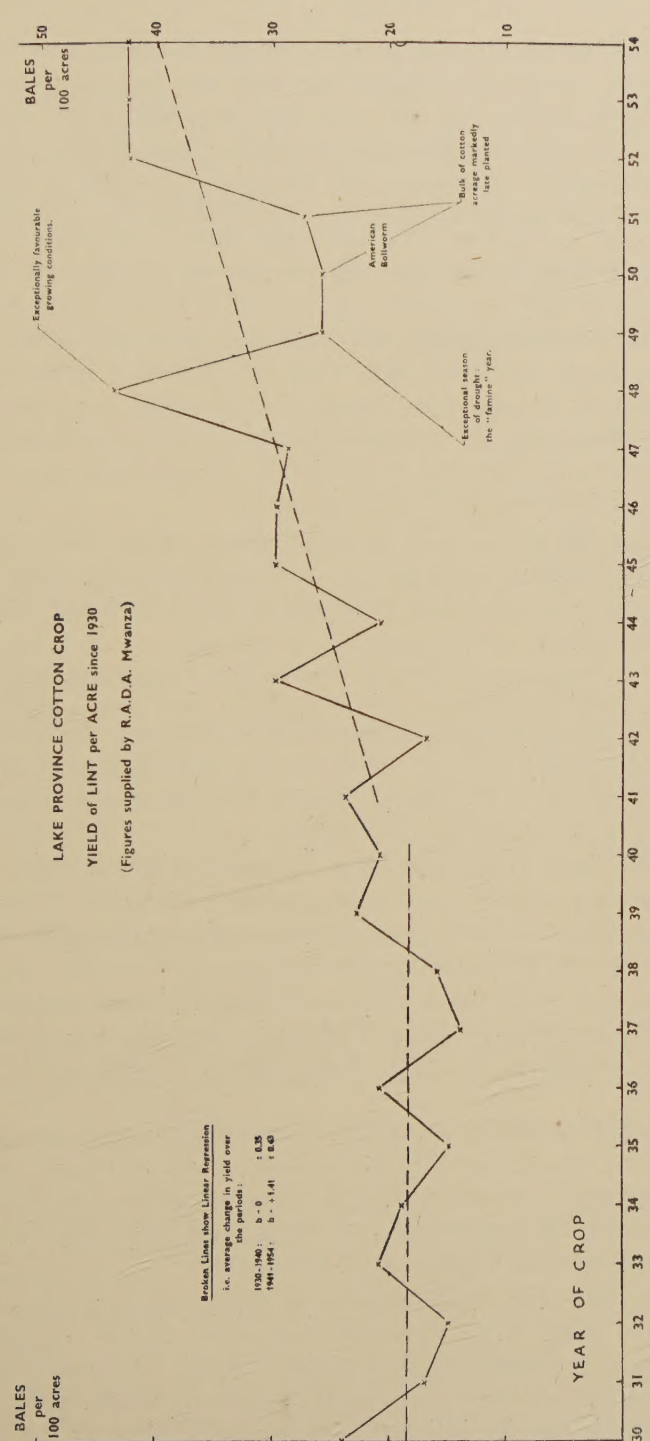
LAKE PROVINCE COTTON CROP
YIELD of LINT per ACRE since 1930
(Figures supplied by R.A.D.A. Mwanza)
BALES per 100 acres
YEAR OF CROP
Broken Lines show Linear Regression
i.e. average change in yield over the periods:
1930-1940: b = 0 ± 0.35
1941-1954: b = +1.41 ± 0.60
Exceptionally favourable growing conditions.
Exceptional season of drought: the "famine" year.
American Bollworm
Bulk of cotton acreage normally first planted

Figure 1.

1948, with an average of 44 bales per hundred acres, was an exceptionally good year climatically, with low loss from pests and diseases (the benefits of new seed and extension work were only starting). In 1949 all crops suffered severely from drought; food had to be imported on a large scale. In 1950 and 1951 much of the cotton was, for various reasons, markedly late planted—into February and even into March, and in 1950 there was severe American bollworm loss. The average for these two seasons was only 26 bales per hundred acres.

In the last three years, 1952, 1953, and 1954, the average works out very nearly the same each year—42 bales per hundred acres. These were by no means exceptionally good years, and each had its cropping difficulties; the acreages planted differed considerably, and also the seasonal influences on the crops. In all three, however, the majority of the cotton was timely planted.

Taking the Province as a whole, yields varied enormously this season; in the Shinyanga district they were especially poor; in the developing district of Geita, especially on the lake fringe, they were very good indeed.

In the strain trials in two of the Ukiriguru district plots the mean yields of Uk48/Uk51 were around 2,000 lb. seed cotton per acre; in two others the mean yields were around 1,400 lb.; in five others they averaged around 1,000 lb. Of 16 district plots, 2 were comparative failures. (Two of the district plot cultivators each received over Shs. 700/- from 2/3rd of an acre of cotton.)

In the Lake Province Cotton Committee fertiliser trials, on hill sands, in the closely cultivated Mwanza, Bukumbi and Urima chiefdoms, "over the fence" from Ukiriguru, the controls (581 shambas) averaged almost 600 lb. seed cotton per acre.

Uk51 is to cover Geita district and two sub-zones in the Mwanza district in the 1954-55 season; Uk48 is to cover the remainder of the Province, except for Uk 53 in Kome Island. Uk46 is now out of cultivation.

This last season the hazard losses were not major factors affecting production. In general, loss due to insect pests was light. Bacterial blight was locally severe in some of the poorer areas, until checked by the February/March drought. In many such areas the new growth later in the season grew away from the disease.

With the high financial returns from cotton growing in the established areas of the Lake Province there is now a demand for extension to the more marginal fringes. Cotton has been tried before in these areas and given up mainly because of the hazards. Unless these hazards can be mitigated, poorer results than in the accepted areas are to be expected.

Summary of the Main Results and Progress.

The Lake Province 1954 cotton crop, over 91,000 bales, is a record one. The significant improvement in yield per acre over the years is discussed, with reference to the improved seed issues and extension activities. Uk48 was compared with Mz561 in 19 strain trials this season; the mean yield was 71 lb. lint per acre higher than Mz561.

The marked fall in yield, planting after mid January, is discussed; under present conditions and in the absence of major hazards, it is shown that Provincial production is essentially dependent on the extent of the acreage planted before mid January.

First and second residual responses after periods of land resting are somewhat less this season than reported in previous seasons, but on the whole worthwhile.

The now classical Trial (8) continued to give interesting information. A striking result was the large response to the sulphate of ammonia top dressing on the portions of the trial dressed with cotton seed ash in 1944, and assumed, therefore, to be well supplied with phosphate. Sulphate of ammonia similarly top dressed to control plots gave no increase.

There were responses of the usual order to applications of organic manure and phosphate, direct and residual. On Ukiriguru the responses to top dressed nitrogen were very poor owing to the drought. The Lake Province Cotton Committee district fertiliser tests gave phosphate responses similar to last year, and nitrogen responses better than at Ukiriguru.

The increased yields of the Ukiriguru seed issues compared with Mz561 are discussed, and the heavier yielding of some 8/290 strains over mean yields of Uk48/Uk51.

The programme of backcrossing and selection continues. A start has been made adding B_{6m} to the best Ukiriguru strains.

The responses at Ukiriguru to seed treatment against bacterial blight are discussed.

Serious American bollworm attack was reported from the Musoma district. At Ukiriguru there were considerable populations of American bollworm moths, with egg-laying on sorghums and a succession of maize crops, but egg-laying on cotton was quite unimportant.

A report by Mr. P. H. Le Mare discusses some of his first results in the Ukiriguru portion of his work, which is to be extended when a suitable assistant can be stationed permanently at Ukiriguru.

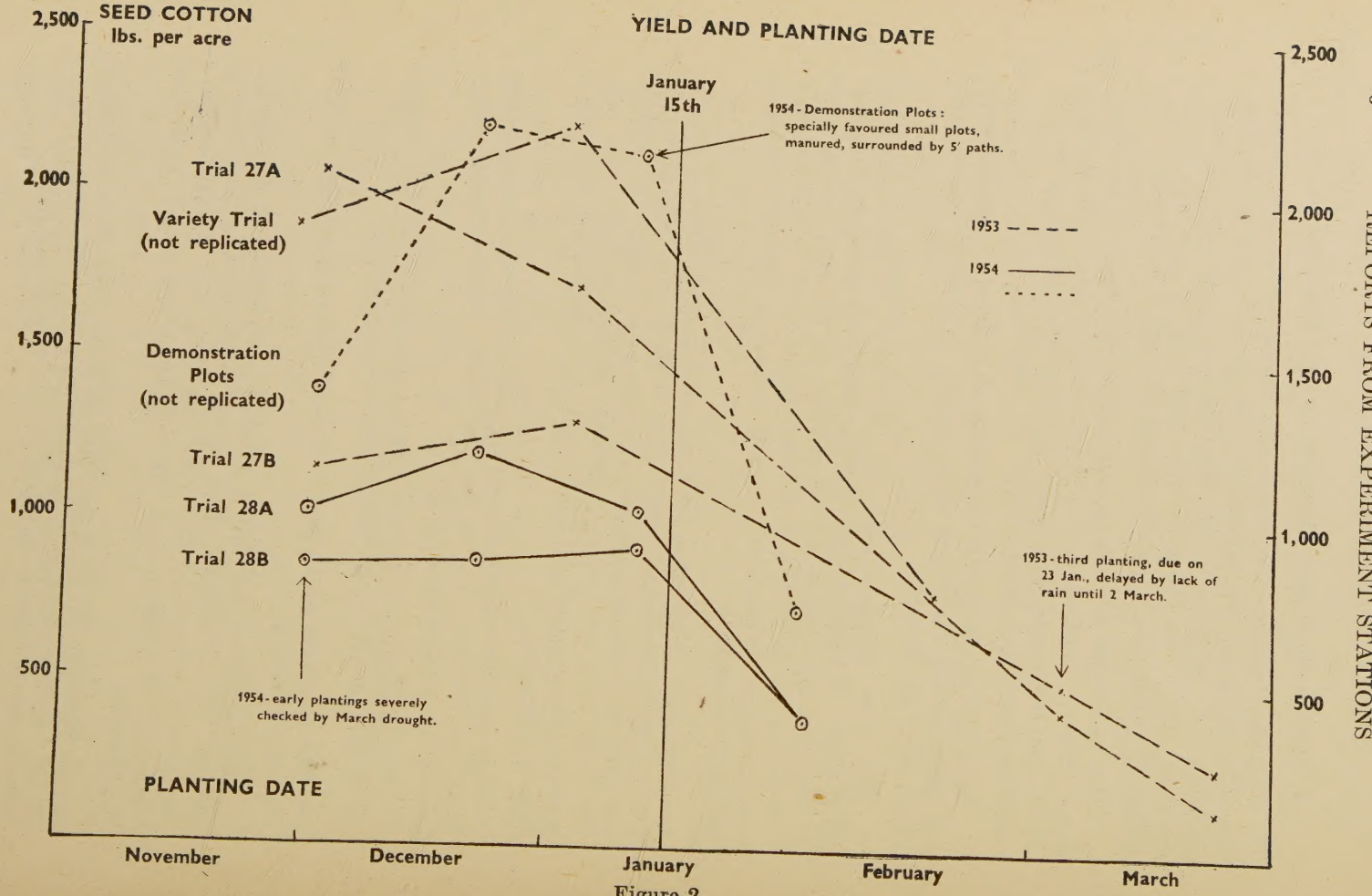
SEED COTTON
lbs. per acre
YIELD AND PLANTING DATE
2,500
2,000
1,500
1,000
500
January
15th
1954 - Demonstration Plots :
specially favoured small plots,
manured, surrounded by 5' paths.
Trial 27A
Variety Trial
(not replicated)
Demonstration
Plots
(not replicated)
Trial 27B
Trial 28A
Trial 28B
1953
1954
1953 - third planting, due on
23 Jan., delayed by lack of
rain until 2 March.
1954 - early plantings severely
checked by March drought.
PLANTING DATE
November
December
January
February
March

Figure 2.

General Account of the Work for the Season.

Husbandry.

Time of Planting.—Over the years the need for timely cotton planting has been stressed as an all-important extension activity. Fig. 2 illustrates the results of the last two seasons, which were droughty years. Both were seasons when there was not cross interference from pests or diseases between the early and the late planting. Planting up until nearly mid January is reasonable, but a marked decline in cropping occurs when planting is delayed until the end of January and into February. This past season the earliest planted cotton suffered slightly more from the March drought than did the late December/early January plantings; the very marked drop in yield, planting at the end of January, is striking.

With a one crop season the cultivator can start preparing land only when sufficient rain has fallen. In the important cotton areas in the North of the Province, bulrush millet, the main food crop, need not be planted until mid January/February. The November, December, early January period should be used for cotton land preparation and planting. The penalties for delaying planting later than early January should be appreciated. If planting is delayed until mid January, the dry spells common at that time of year may delay germination into February, with the same effect as late planting.

Table 1.

Resting Crop Trial.

Ukiriguru—Hill Sand—Trial (7).

12 blocks (6 cotton: 6 bulrush millet) of 8 plots of 1/48·4 acres. Cropping rotation—2 years cotton: 2 years millet.

5 foot ridges, 2 rows at 18″ spacing, 2 plants per hole. Planted 8th December 1953 (cotton); 8th January 1954 (millet).

Five Years Treatments, 1947-48 to 1951-52.	*Second indicator crops.*	
	Cotton.	*Bulrush millet.*
	Seed cotton lb./acre.	*Grain lb./acre.*
Annual cropping—no manure	864 = 100%	573 = 100%
Annual cropping—double supers at 200 lb./acre applied 1952-53	1034 120	790 138
Annual cropping—compost at 6 tons/acre applied 1952-53	1163 135	786 137
"Tumbledown" fallow—grazed	938 109	766 134
"Tumbledown" fallow—not grazed ...	985 114	779 136
Planted fallow—grazed	1018 118	851 149
Planted fallow undersown with *Tephrosia* and *Crotalaria*—grazed	1095 127	852 149
Planted fallow undersown with local creeping legumes—grazed	1069 124	773 135
Sign. Diff. (P=·05)	Not significant	123 21
S.E.	± 66·6	± 43.0

Land Resting.—In Trial (5) second residual responses were measured, the third indicator crops since digging-in the treatments. Only the continued response from the "tumbledown" fallow treatment was significant in the cotton portion of the trial; responses in the bulrush millet portion of the trial were also low.

In Trial (7), Table 1, first residual responses, second indicator crops, were less than in some years. There were for cotton the usual phosphate and compost responses, with fair responses following the planted fallow treatments, but with lesser effects following the "tumbledown" treatments. In the millet portion of the trial the increases were significant and appreciable.

This past season a trial was laid down to test the effects of one season resting treatments. This is now under cotton for the 1954-55 season; and a second similar trial has been laid down, for cropping the following season.

At Lubaga the first results of a series of trials testing the effects of 3, 4, and 5 years rest under *Cenchrus ciliaris* are coming in. There, the grass rest and "tumbledown" fallow give no increase in the first indicator crop, although there has been a small increase in the yield of cotton in the second year.

TABLE 2.

MANURIAL TRIAL.

Ukiriguru—Hill Sand—Trial (8).

8 blocks of 6 plots, treatments applied in November, 1944. Half plots, each 1/35·6 acres, were manured at the same rates in November, 1952, or received sulphate of ammonia at 175 lb. per acre in March, 1953, and March, 1954.

5 foot ridges, 2 rows at 18″ spacing. Native bulrush millet, planted 14th January 1954.

Treatments.	*Yield of bulrush millet grain in lb./acre.*		
	Tenth indicator crop.	*Second indicator crop.*	*Yearly applications.*
	Treatments applied 1944.	*Treatments re-applied* 1952.	*S/Ammonia applied* 1953 & 1954.
Control—no manure .	467	—	473
Compost—3 tons per acre	417	516	—
Farm yard manure—3 tons/acre ...	497	535	—
Compost—7 tons per acre	537	662	—
Farm yard manure—7 tons/acre ...	596	723	—
Cotton seed ash—1½ tons/acre ...	640	—	1128
S.E.	± 31·2	± 44·6	± 44·6
Sign. Diff. (P=·05) — in the same column	90	128	128
in the same line		96	
not in the same line or column		120	
Interaction: Ash × Nitrogen		+241 ±28·0	

Manuring and Fertilisers.—The results from Trial (8) are given in Table 2. Millet was the indicator crop. The ninth residual responses are, as might be expected, only from the heavier manurial applications and the dressing of cotton seed ash. A particularly striking result is the response to sulphate of ammonia top dressed to portions of the trial treated with cotton seed ash in 1944, compared with a similar top dressing to controls. (The ash plots are assumed to be amply supplied with phosphate.) There was a spectacular increase, nearly 80% or 480 lb. bulrush millet grain per acre. The same increase, this last season, would not have been obtained had cotton been the indicator crop—as is shown in the two NPD trials. Sulphate of ammonia similarly top dressed to control plots gave no increase. (Refer also to Mr. Le Mare's report.) It is important in studying these agronomic responses to bear in mind the differences between cotton reactions, and the reactions of different grain crops.

TABLE 3.

NPD EXPERIMENT.

Ukiriguru—Hill Sand—Trial (9).

Main plots split to give 3 × 2 factorial, testing all combinations of:—
(Main plots) n_0, n_1 0, 250 lb. sulphate of ammonia per acre.
(Split plots) d_0, d_1 0, 6 tons compost per acre.
p_0, p_1, p_2 0, 75, 150 lb. double supers per acre.

6 replications of 12 plots, each 1/69·7 acres. Compost applied 15th September, 1953 (also in December, 1950); phosphate applied 16th September, 1953 (also in 1946, 1947, and December 1950); nitrogen applied 25th February, 1954 (annually).

5 foot ridges, 2 rows at 18″ spacing, 2 plants per hole. Planted 8th December, 1953.

YEAR OF APPLICATION.

Mean yields: Seed cotton in lb. per acre.

	(1)	d	n	nd
p_0	674	1204	696	1140
p_1	882	1240	1109	1260
p_2	1008	1314	1091	1305
Sign. Diff. (P = ·05) –				
in the same half of table			140	
in different halves			196	

Main effects:

	n_0 1,054	p_0 929		d_0 910	
	n_1 1,100	p_1 1,123		d_1 1,244	
		p_2 1,179			
S.E.	± 29·6	± 24·6		± 20·1	

Interactions:

	NP_2 + 29	P_2D −113	ND − 64
S.E.	± 34·8	± 34·8	± 28·4

In Table 3 are set out the results from Trial (9). In this trial the compost and phosphate responses are measured over a three-year period, the nitrogen top dressing being applied every year. The 1953-54 organic and phosphate results are responses in the year of application, but in addition there will have been accumulated residual benefits. The profits were especially large from the organic application; less, but still very worthwhile, from the applications of double superphosphate. With compost and the heavier dressing of superphosphate, the crop was nearly doubled. Responses to sulphate of ammonia were very small, only evident in the presence of phosphate. Better grown lusher plants suffered more severely from the drought.

The results of Trial (26) are given in Table 4. Here the compost and phosphate figures are first residual responses; they follow more or less the usual course, but again this season the nitrogen responses are very small.

TABLE 4.

NPD EXPERIMENT.

Ukiriguru—Hill Sand—Trial (26).

5 replications of 2 × 2 factorial, with split plots of 1/69·7 acres giving 4 nitrogen treatments. Compost and phosphate applied 29th November, 1952; sulphate of ammonia applied 20th November, 1953, at planting, and 10th February, 1954, at flowering (also in the 1952/53 season).

5 foot ridges, 2 rows at 18″ spacing, 2 plants per hole. Planted 20th November 1953.

p_0, p_1 0, 150 lb. triple supers per acre.
d_0, d_1 0, 6 tons compost per acre.
n 175 lb. sulphate of ammonia per acre in 1953 and 1954.

FIRST RESIDUAL YEAR—NITROGEN RE-APPLIED.

Mean yields: Seed cotton in lb. per acre.

Nitrogen treatments.	*Second indicator crops Compost and Phosphate.*				*Nitrogen means.*
	(1)	d	p	pd	
No nitrogen	579	774	796	929	771
At planting	630	807	942	915	824
At flowering	568	861	936	901	817
1952-53 residual	606	909	870	971	840
Sign. Diff. (P=·05) — in the same column			135		68
in different columns			159		S.E. ± 23·8
P and D means	596	839	887	930	
Sign. Diff.			95		
Main effects: P	+ 191				
D	+ 143		S.E. ± 31·0		
PD	− 100				

As last year, there were Lake Province Cotton Committee tests in the Mwanza-Bukumbi-Urima chiefdoms, "over the fence" from Ukiriguru, testing in African 'shambas' dressings of 90 lb. of double

superphosphate per acre, with and without a top dressing of 200 lb. sulphate of ammonia. Control yields were lower than last season, but responses to phosphate were very similar—an increase of over 140 lb. seed cotton per acre. The nitrogen responses were better than at Ukiriguru, possibly due to scattered March showers; but considering that any nitrogen response is for the year of application only, the use of sulphate of ammonia cannot be recommended to the local cultivators. Phosphate manuring in these hill sand areas is entirely different. Results over the years are such that the encouragement of phosphate manuring for cotton in these areas is now fully justified.

The co-operative movement in the Lake Province has displayed interest in the use of fertilisers, and it seems probable that the sale of phosphate to members will be organised. It must be remembered, however, that while the use of phosphate should be encouraged to the full in these areas, organic manure is the more valuable dressing.

Spacing.—Superimposed on to the time-of-planting trial, already referred to, were various spacings, plus comparisons of top dressed nitrogen, and no nitrogen. The time-of-planting results have already been discussed. The nitrogen responses were nil. There were two rows per ridge, and two plants were left per hill. The spacings were 9″, 12″, 18″ and 36″ in the row. Final stands varied around 70%. There were no significant yield differences. This adds support to the general view that with reasonable spacing there can be a fair loss of stand, e.g., from termite damage, without drop in yield.

In the seed dusting trial, discussed later, it is shown that reduction in stand caused by bacterial blight was not a factor in reducing yield.

Ridge Tying.—The results from the main Ukiriguru ridge-tying trial are set out below.

	Seed cotton lb./acre.	*Bulrush millet grain. lb./acre.*
Poor ridges not tied	777	719
Good ridges tied ...	941	798
Sign. Diff. (P.=·05)	89	Not sign.
S.E.	± 27·8	± 35·4

The difference in the reactions to treatment of the two crops, cotton and bulrush millet, is again seen. There was promise, in the cotton portion of the trial, of even larger profit from tying, until the March drought affected the lusher growth in the tied plots.

At Lubaga, where the soil is shallow and water conservation is of major importance, tie-ridging is the most important factor in increasing yield. The "ibushi" ridging trial—Table 5—shows that this operation gave increases up to 400 lb. per acre seed cotton, compared with flat cultivation. This trial is being extended to measure the effect of the treatments each year on both cotton and sorghum yields.

On the "ibambasi", cemented hard soil, at Lubaga, the tie-ridged plots considerably outyielded flat cultivation, but the results were not statistically significant.

TABLE 5.

RIDGING TRIAL.

Lubaga "Ibushi" Soil.

6 blocks of 5 plots of 1/29·0 acres. One row per ridge: spacing 12″ in 3 foot rows, 7″ in 5 foot rows. Planted 4th November, 1953.

Treatments.	*Seed cotton lb./acre.*	
Flat cultivation—3 foot rows ...	491	=100%
3 foot ridges—not tied	631	128
3 foot ridges—tied	915	186
5 foot ridges—not tied	524	107
5 foot ridges—tied	725	148
Sign. Diff. (P=·05)	106	22%
S.E.	± 35·8	

Rotation.—There were again no significant differences in the Ukiriguru rotation trial, where continuously planted cotton and continuously planted bulrush millet are compared with a simple rotation, a 1 : 2 rotation, and a 2 : 2 rotation.

A similar trial at Lubaga with Dobbs sorghum as the grain crop, now in its fifth year, showed a small increase in cotton yields in the longer rotations.

Weeding.—In observation plots, not replicated, various standards of weeding were compared. Serious delay in weeding halved the crop.

COTTON BREEDING.

Uk48 in 1953-54 covered most of the Province, except for Uk46 in the Shinyanga zone, Uk51 multiplication in part of the Buchosa zone, and Uk53 multiplication in part of Kome Island. Uk51 has given an excellent multiplication rate. From just over 1 ton issued for first multiplication in 1951-52, it is reported (Regional Assistant Director of Agriculture, Mwanza) that, at the end of the third season of growing, there were 2,480 tons of seed for planting.

In yielding capacity Uk48 and Uk51 seem to be very similar, with Uk46 poorer; all are a marked improvement on Mz561. From the Shirley Institute spinning reports Uk51 would appear slightly better in spinning qualities and yarn appearance. Uk53 has given no improvement in yield over Uk48 and Uk51, nor, as was hoped, do the spinning qualities show improvement. The multiplication on Kome Island continues, but it may well be that Uk53 multiplication will not proceed further.

There were three strain trials at Ukiriguru—one 49 strain balanced lattice on hill sand, a similar trial in the valley bottom 'mbuga', and a "poor land" 25 strain balanced lattice trial of the newer material. In the main hill sand trial there was heavy loss from termites; complete stretches of rows were destroyed. In the results given, only 3 replications where final stands were reasonable have been used. In the 'mbuga' trial there was severe *Lygus* attack on the re-growth after the break of the March drought; practically no top crop was set; there was only a very small July picking and no August picking. (This is in contrast to the main hill trial where one quarter to one half of the total crop was picked in August.) The 'mbuga' results are, therefore, from a crop arrested in development. Further, all these Ukiriguru results have to be reviewed in the light of the drought.

The Lubaga trial, again a 49 strain balanced lattice, was very accurate.

The district plot trials were 16 strain balanced lattices, the cropping results from nine of which, the more uniform and the more accurate, are shown in Tables 6 and 7.

It is difficult to give any accurate assessment of the general profit to the Province due to the Ukiriguru seed issues; but the profit outlined below may be considered a fair indication of the increase potential from the strain issues, given attention to timely planting and reasonable agronomic improvement. In the 19 strain trials where Mz561 was compared with Uk48—16 district plot trials, and 3 main trials, 2 at Ukiriguru and 1 at Lubaga—the mean yield increase of Uk48 compared with Mz561 was *71 lb. lint per acre.* (An average increase of 2 lb. lint per acre on this last season's acreage would have been equivalent to just over 1,000 bales addition to the Provincial crop.) Had the yields from these trials been a true reflection of the Provincial yields, the increase this last season from growing Uk48 instead of Mz561 would have represented over 38,000 bales—with a baleage value of somewhere around £2,000,000. (But the Provincial mean yield was 168 lb. lint per acre, compared with 343 lb. lint per acre for Uk48 in the 19 trials.) The strain trials covered a range of areas and conditions, and in the district plots were cultivated by plot holders.

In Table 6 it will be seen that in the main trials last season Uk48 and Uk51 averaged somewhere around a 35% increase (lint) over Mz561. In the 'mbuga' arrested trial the increase was only just over 11%; in the hill sand trial the increase was about 30%, and at Lubaga nearly 70%. The value of the seed issues seems to be greater inland from Ukiriguru, and where growing conditions are poorer.

In Table 7 are set out for Ukiriguru, Lubaga, and district plots the cropping results of some of the more important Ukiriguru strains, against the means of Uk48/Uk51. It will be seen that the better 5/57 and 6/318 strains yielded around the Uk48/Uk51 level. Strains in the

Tables 6 and 7.

1954 Strain Trials.

(Lint yields in pounds per acre: S.D. and S.E. applicable to both tables.)

Table 6.

Group	Strain	Ukiriguru			Lubaga	Main Trials	District Plots								D. Plots
							Ukerewe		Geita		Nassa	Kwimba	Musoma		Shinyanga	
		Hill Sand trial	"Mbuga" trial	Poor land trial. Exhausted Hill Sand	"Ibushi" soil	Average as % of Mz561	Buhima	Ragata	Arugongo	Ibondo	Shigala	Mahuki	Sumanda	Lalago	Butubira	Average as % of Mz561
	Mz561	269	336	—	245	100%	256	632	601	227	324	210	330	137	194	100%
	Uk46	313	355	—	350	120	294	673	675	272	308	280	438	207	296	118
	Uk48	375	380	203	394	135	323	686	731	284	351	290	486	225	270	125
	Uk51	324	379	203	436	134	336	670	677	288	328	303	421	200	280	120
	Uk53	380	369	221	406	137	337	597	715	269	306	275	507	230	270	120
Table 7.						Average as % of Uk48/51										Average as % of Uk48/51
Controls	Uk51, Uk48	349	380	203	415	100%	330	678	704	286	340	296	454	213	275	100%
ex 5/57	0/89	392	333	—	430	101	272	694	713	257	338	279	446	227	263	97
	0/95	411	340	—	362	97	315	640	756	316	323	270	462	228	297	101
ex 7/150	0/282	381	318	—	435	99	263	674	734	270	324	290	499	206	299	99
	0/285	343	261	—	373	85	290	495	717	239	275	283	335	177	263	86
	1/613	409	267	169	346	89										
ex 6/318	8/95	413	343	—	374	99										
	8/151	388	373	—	378	100										
ex 8/290	8/290	418	368	—	417	105										
	0/331	364	452	—	411	107	386	621	746	309	330	332	430	219	235	101
	0/334	461	427	—	472	119	350	719	842	321	309	333	499	312	276	111
	1/667	406	400	208	465	110										
ex 7/367	0/457	353	360	—	425	99										
	0/460	380	299	—	377	92										
Sea Island × U4	1/686	397	380	227	451	108										
Sign. Diff. (P=·05)		77	49	37	36		52	109	76	47	43	49	89	47	48	
S.E.	±	27·6	17·5	13·1	13·0		18·2	38·3	26·6	16·7	14·9	17·1	31·1	16·6	16·7	

important 8/290 group out-cropped Uk48/Uk51; the most important is 0/334, followed by 1/667. In the main trials 0/334 is 19% up (lint), and for the nine district plot trials 11% up. The high yielding of 1/686, a survivor of the Barberton Sea Island × U4 material, is interesting. 0/334 and 1/667 in spinning tests gave quite good yarn strength and fair yarn appearance. It is hoped to constitute a Uk55 in which these two strains very probably will feature.

Ginning Percentage.—In Table 8 are shown the ginning percentages (optimum at Ukiriguru on a hand gin) for a range of strains covering a range of localities. The level, compared with the results shown in Fig. 3 of the 1952-53 report, is markedly the lowest in the past five seasons. The average ginning percentage of the same five strains in different localities shows a range of 1·5%.

Lint Length.—The lint length variations shown in Table 8 illustrate the view that there are considerable lint quality variations within the Province. Lint from poorer growing conditions, and from Shinyanga areas, is very often shorter than from easier areas with better growth. This is strikingly demonstrated by the Lagana (Shinyanga district) measurements; growing conditions at the Lagana district plot were especially difficult and yields very poor.

Seed Coat Damage.—Also in Table 8 are set out the percentages of seed coat chalazal damage. This is now to become a routine assessment at Ukiriguru. It will be seen that there are differences between strains and again considerable locality variations. 7/150 strains are amongst the worst; the worst representatives gave figures in the Ukiriguru "poor land" trial up to 60% damaged seed; but it is interesting to note that these same strains in earlier spinning tests were above the average in yarn appearance grading. There is segregation in 7/150 for this seed coat damage. Again this season the 7/150 strains have been disappointing in their cropping (Table 7).

The visit of Mr. Underwood of the Shirley Institute with Mr. Evenson of Namulonge was much appreciated, as was the opportunity that it gave for discussing Shirley Institute and Namulonge assessments of cotton quality.

Crossing Programme, Ukiriguru Strains × Albar 51.—This continues to be the most important part of the breeding programme. In-season the main work was backcrossing from second to third backcross. Out-of-season the main work was selfing the best of the third backcross single plant selections. Selections from this third backcross selfed material are to be planted as single plant lines this 1954-55 season. As an insurance, the main lots are to be carried to fourth backcross in 1954-55. In 1952 and 1953 in-season material, up

to the second backcross stage, there has been a fair proportion of "wilter unbalanced" types. In the out-of-season third backcross single plant lines, kept watered, only one suspect "wilter" was observed. In first backcross material being backcrossed again out of season, four "wilters" were observed in one lot.

All seed was treated with *Xanthomonas* suspension and plants were later needle-prick inoculated. Susceptible plants were rogued out.

A start has been made with the adding of B_{um} to the best of the Ukiriguru lots. Seed of BAR 14/38 (B_2B_{um} Sakel) was obtained from Shambat. This is gratefully acknowledged. F_1 material will be planted when ready, in-season in 1955, for first backcrossing.

TABLE 8.

1954 STRAIN TRIALS.

Lint and seed characters.

Strain / *Locality*	Mz561	Uk48	0/95 5/57 group	0/285 7/150 group	0/334 8/290 group	*Mean*
Ginning Percentage.						
Ukiriguru	31·2	32·8	34·8	32·4	33·1	32·9
Lubaga	31·5	32·4	33·5	34·3	33·7	33·1
Ragata	31·0	32·2	34·5	33·2	32·2	32·6
Arugongo	31·5	32·9	34·5	34·1	33·0	33·3
Mabuki	32·0	33·5	35·2	35·0	34·0	33·9
Somanda	31·8	34·5	36·3	34·3	33·8	34·1
*Lagana	31·5	32·6	33·0	34·2	35·0	33·3
Mean	31·5	33·0	34·5	33·9	33·5	
S.E.			± 0·26			± 0·31
Lint Length. (Seed cotton halo length in mm.).						
Ukiriguru	31·0	31·7	31·3	30·1	32·0	31·2
Lubaga	31·4	30·4	33·3	—	33·1	32·0
Ragata	28·3	32·6	32·1	31·2	31·6	31·2
Arugongo	31·6	33·3	30·8	33·0	29·8	31·7
Mabuki	31·9	33·4	32·6	32·7	31·1	32·3
Somanda	30·9	34·1	32·1	32·1	31·9	32·2
*Lagana	26·7	29·7	26·8	29·1	30·0	28·5
Mean	30·3	32·2	31·3	31·4	31·4	
S.E.			± 0·45			± 0·53
%Seed Coat Chalazal Damage.						
Ukiriguru	22	25	20	45	32	29
Lubaga	22	20	21	46	26	27
Ragata	6	11	7	26	12	12
Arugongo	14	25	16	47	22	25
Mabuki	8	15	14	18	14	14
Somanda	10	19	14	30	10	17
*Lagana	18	17	18	27	17	19
Mean	14	19	16	34	19	
S.E.			± 1·7			± 2·0

*Lagana, Shinyanga district, on "ibushi" soil, very badly droughted, was the poorest yielding district plot.

Diseases and Pests.

Diseases.

Bacterial Blight (*Xanthomonas malvaccarum*). In two previous seasons the effectiveness of seed treatment in reducing the incidence of seedling infection has been demonstrated. Information on the influence of seed treatment on yield has been inconclusive, trials being complicated by the occurrence of later infection arising either from trash or by spread from plot to plot.

During the past season, seed treatment trials were laid down in which each plot was separated from its neighbours by a distance of not less than 20 feet. The intervening spaces were planted with bulrush millet and velvet beans.

Trial "A" was laid down in a field which had not carried cotton for at least five seasons, and in this trial the mean increase in yield due to seed treatment was 177 lb. per acre of seed cotton or 25%. Seed treatment did not influence the proportion of stained (Grade 'C') seed cotton. In addition to the occurrence of bacterial boll rot, stainers (*Dysdercus* spp.) were also present, and a detailed assessment of the relative importance of these two agencies in the production of stained seed cotton was not attempted.

Details of the yields and stands are shown in Table 9, together with an indication of the incidence of bacterial blight at the seedling stage.

Table 9.

Seed Treatment Trial "A".

Njihiji III. Good rotated land.

8 blocks of 5 plots each 1/48·4 acres. 5 foot ridges, 2 rows at 18" spacing, 2 plants per hole. (Complete stand – 11,616 per acre). Planted 2nd December 1953. Refilled 17th December 1953 and 15th January 1955.

Treatments	*Yield of seed cotton*		*Final stand* %	*% seedlings affected by bacterial blight at 44-46 days*	
	lb./acre	*Grade "C"* %	*complete stand*	*True-leaf lesions*	*Main-stem lesions*
Untreated	703=100%	17·5	53·4	95·5	52·3
Sulphuric acid	859=122%	17·4	60·2	11·7	2·4
Perenox 1:300 w/w	897=128%	20·2	66·8	51·5	5·0
Agrosan GN5 1:300 w/w	920=131%	15·9	68·6	4·7	nil
Spergon 1:300 w/w	845=120%	17·8	61·9	17·8	0·5
S.E. ...	± 35	± 1·3	± 2·7	Average number of seedlings scored per treatment = 223.	
L.S.D. (P=·05)	101= 14%	Not sign.	7·9		

From the figures shown in this table there appears to be a relationship between yield and stand, but the error regression of yield on stand was not significant. Loss of stand was caused both by bacterial

blight and by activity of termites. Plots with low stands which were grown from treated seed did not in general show depressed yields and it would appear that under the conditions of the trial, loss of stand was not of itself sufficient to account for the observed loss of yield in the untreated plots. This is illustrated by the data shown in Table 10 from which it can be seen that block yields are not related to stands, although the range of block stands is comparable with that for treatments.

Table 10.

Seed Treatment Trial "A".

Block yields and stands.

Blocks	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*S.E.*	*Mean*
Yield seed cotton lb./acre	866	837	806	871	850	842	816	845	±44	842
Final stand % Complete stand	67·5	72·1	66·8	61·8	52·1	53·8	57·8	65·6	± 3·5	62·2

Trial "B" was planted in a field of markedly low fertility where cotton had been grown for the previous four seasons and had suffered moderate to severe attacks of bacterial blight. Under these conditions, the early attack of the disease was very severe, and numerous seedlings in the untreated plots were killed. With the drought, however, the progress of the disease was arrested, and the new growth following the April rains was largely free from serious bacterial blight.

Table 11.

Seed Treatment Trial "B".

Nyashimba VA. Poor, trash infested land.

6 blocks of 3 plots each 1/69·7 acres. 5 foot ridges, 2 rows at 18" spacing, 2 plants per hole. (Complete stand = 11,848 per acre). Planted 1st December 1953. Refilled 16th December 1953.

Treatments	*Yield of seed cotton*		*Final stand % complete stand*	*% seedlings affected by bacterial blight at 48-50 days*	
	Total lb./acre	*Grade "C" %*		*True-leaf lesions*	*Main-stem lesions*
Untreated	441=100%	17·2	43·0	100	51·9
Sulphuric acid	516=117%	16·6	60·4	87·2	2·9
Perenox	618=140%	16·8	64·3	95·8	9·1
S.E. ...	± 44	± 1·1	± 2·8	Average number of seedlings scored per treatment = 359.	
L.S.D. (P=·05)	135= 31%	Not sign.	8·8		

As the season progressed, pronounced fertility irregularities appeared in this trial and of ten replications laid down four, covering the area worst affected by these irregularities, were rejected. The analysis, based on the remaining six replications, showed a mean increase in yield due to seed treatment of 126 lb. per acre of seed cotton or 29%. Detailed results are shown in Table 11. The error regression of yield on stand was not significant.

Information obtained during the season on the occurrence of trash infection was inconclusive. The results of seedling scores in trials "A" and "B" (Tables 10 and 11) indicate a higher incidence of leaf infection in the seedlings grown from treated seed on the poor trash infested land in trial "B", although the seed used in both trials was from the same bulk. It may be that the additional infection in trial "B" arose from trash, but it has frequently been observed that bacterial blight becomes established more readily on cotton growing under conditions of poorer fertility and these two factors are confounded in the trials. Moreover, other factors governing the establishment of the disease may not have been similar in the two trials, and the seedlings in trial "B" were 2-6 days older when scored.

In a third trial planted on land which had been under grass rest for four years, trash was applied to half the plots. The trash, which was known to be heavily infested with *Xanthomonas,* was applied in the furrows before ridging at the rate of 700 lb./acre (air-dry trash). Half the plots were planted with acid treated seed and half with untreated seed, giving a 2 × 2 factorial set of treatments.

A seedling score at six weeks after emergence showed that there was no increase in the incidence of seedlings showing leaf or stem lesions in the trash-treated plots, and the yield data showed that trash applied in this manner had no influence on yield. The mean increase due to seed treatment in this trial was 99 lb. per acre of seed cotton, an increase of 8% on the mean yield for untreated seed which was 1230 lb./acre.

The results of these trials show that seed treatment gave a worthwhile increase in yield on both rotated and trash infested land, and indicate that under the particular conditions of this season, seed borne infection was more important than infection arising from trash.

Attempts to assess the benefit from seed treatment with Perenox under conditions of native cultivation gave inconclusive results. There was a general impression of a less severe attack of bacterial blight in those areas planted with treated seed, but this was not conclusively reflected in scores of the incidence of plants with stem lesions (at 2-4 months old) recorded in treated and untreated areas. Yields were recorded by staff of the Department of Agriculture from sample plots on either side of the seed treatment 'boundary'. The results were very

variable and did not show a significant increase in yield due to seed treatment.

Last year some 2,200 tons of seed were treated with Perenox, this being enough to plant nearly half the Provincial crop. In the current year, 4,700 tons have been treated, enough for the whole crop.

Wilt (*Fusarium oxysporum f. vasinfectum*).—In March some wilted plants, similar to those observed in previous seasons at Lubaga, were discovered in a group of native holdings on lake shore sand in Geita district, where Uk48 was being grown. Affected plants occurred singly or in patches of up to 30 yards in diameter, over an area of about a quarter of a square mile. As observed previously at Lubaga there was no apparent association between the occurrence of the disease and continuous cropping with cotton. Much of the cotton in which affected plants were observed was growing on land which had carried cassava in the previous season and some was following 'tumbledown' fallow. In a few holdings, however, there had been no rotation. The wilt symptoms were severe and in many cases the plants had died. In all cases there was staining of the vascular tissue.

Laboratory examination of affected plants revealed fungal hyphae in the xylem and a *Fusarium sp.* was isolated from vascular tissue from both stem and roots.

Specimens were sent to the Senior Plant Pathologist, Dr. G. B. Wallace, who also isolated a *Fusarium sp.* and showed it to be pathogenic to Uk48. The pathogen was confirmed as *F. oxysporum f. vasinfectum* by Dr. W. L. Gordon in Winnipeg.

Pests.

Taking the Province as a whole, loss due to insect pests was light, though there were exceptions.

American Bollworm.—In part of the Musoma district there was American bollworm loss, starting in June and extending into July—associated with plantings of maize and chick-pea; later there was *Lygus* damage to the sappy new top growth. Quite considerable total loss was caused in the area. The percentage of Grade C bought in the Musoma zone was exceptionally high for this year compared with other zones.

At Ukiriguru the nice balance was again demonstrated between American bollworm egg-laying on a range of host crops, of which cotton is but one.

In March the Botanist reported American bollworms in close-panicled sorghum heads, from 20 up to more than 100 per 100 heads. There were many fewer in the more open-panicled heads. In early May in open-headed types, no American bollworms were found in

unbagged heads in the breeding plots, but in around 25% of the bagged heads bollworms were found. These results, and other reports, would seem to indicate predator or bird attack on the bollworms in the more easily attacked open-panicled heads.

This aspect of the extension of the growing of close-panicled early maturing sorghums generally in the cotton growing areas requires consideration, involving, as it may, possible foci of American bollworm build-up.

At Ukiriguru there were plantings of trap-crop maize at intervals, to give American bollworm egg-laying cover to the cotton. Tasseling maize in May, June, and July carried larval populations of the order of 40 to over 100 per 100 maize plants. Maize planted before mid February was all cut while carrying larvae, and used for ensilage. The station bulk maize was planted after mid February.

In spite of the considerable American bollworm moth populations that must have been present in the Ukiriguru area in the main period of cotton flowering, American bollworm attack on cotton was quite unimportant. The other host crops had kept the egg-laying off cotton.

Spiny Bollworm.—There were reports of some spiny bollworm loss throughout the Province. At Lubaga in mid March 1,100 per acre were recorded in one count.

Pink Bollworm.—Very occasional pink bollworms were reported in the lake shore area. At Ukiriguru in-season, none was observed: but in the out-of-season crossing plot (half an acre) considerable numbers were observed from late October. Affected bolls were picked off and buried.

Lygus.—Reference has been made to *Lygus* damage to the late top growth in parts of Musoma district, developing in the top growth after the May rains, and following American bollworm damage. Such *Lygus* development tallies with the reports of what is happening in the South Nyanza Province of Kenya.

There was serious *Lygus* damage in the Ukiriguru valley bottom 'mbuga', where cotton was grown adjacent to plots of early maturing sorghums. The 'mbuga' cotton had been badly checked by the March drought. In late April/May there was a sappy top regrowth. Starting in late April through into June, there was very severe *Lygus* attack. As a result the July picking was negligible, and there was was nothing at all to pick in August. Contrasted with this, the hill sand trial gave from one quarter to one half of the total crop in the August picking. The assumption is that the 'mbuga' attack was a transference of *Lygus* populations from the ripened sorghum plantings to the sappy cotton top-growth.

On another area of the station, early maturing sorghum types, comparatively late planted, were growing adjacent to cotton; the sorghums carried through a big *Lygus* population; but there was no noticeable loss on the adjacent cotton.

Jassid.—In the 1951-52 Report it was stated that, with the distribution of the new Ukiriguru strains, it was hoped that jassid would no longer be a major factor liable to affect the Lake Province cotton crop. In 1952-53 jassid was quite unimportant. But this last season has shown that there must be no relaxation in the task of getting as high a degree of jassid resistance as possible.

Quite early in the season there was noticeable jassid damage on Uk48 in poorer grown "shambas". In the new growth in April after the drought check, there was at first poor leaf hair expression, and there was jassid damage; but especially in the better grown cotton, leaves developed adequate hairiness and the plants quickly grew away from any jassid expression. The importance of the observation lies in the need for maintaining as high a degree of jassid resistance as possible in any seed issue.

Stainers.—In the South-West areas of the Province, for example, Lubaga, where stainers can be a serious menace, this season the damage was light. Population counts at Lubaga were low, never as much as 1,000 to the acre. Routine stainer poisoning was carried out. A trial of the standard arsenic-blob treatment was laid down. Unfortunately, it was planted late; no results were obtained.

In the Nassa, Musoma and Ukerewe mainland areas, where normally stainer damage is low, stainer populations were exceptionally high.

In the out-of-season crossing plot at Ukiriguru in November/December, stainer populations—*D. superstitiosus, D. nigrofasciatus,* and *D. fasciatus*—were high, causing heavy boll infection.

At Ukiriguru the proportion of Grade C was around 15%; at Lubaga exceptionally low, 12%; in the district plots it varied from as low as 7%, with most of the plots 10% to 20%, up to 59% at Lalago, South-West Maswa.

Termites.—Termites reduced stands considerably in some areas.

Soil Chemistry Studies at Ukiriguru.

BY

P. H. LE MARE.

A start was made in 1954 with laboratory studies of some of the soil fertility problems at Ukiriguru. Two visits each of a month were

made to Ukiriguru in February and May 1954. Progress will be slow so long as the work has to be done during visits from Namulonge. A Makerere graduate in Chemistry will be appointed to work at Ukiriguru as soon as a suitable man can be found. At present (September 1954) it seems unlikely that there will be anyone available before the end of 1955.

The work is directed towards the elucidation of the results obtained in field experiments over the past ten years. In particular we wish to know what are the operative factors in the long term effects of land resting and organic manures. Evidence from field experiments suggests that phosphate is primarily responsible for these effects. In addition sulphate of ammonia has been shown to increase yields, particularly when phosphorous is also given. The nitrogen status of the soils will be studied and the possibility that sulphur may be effective in sulphate of ammonia will be borne in mind.

In time we hope to make a study of the crop-soil-water relationship at Ukiriguru. The superiority of tied ridges over untied ridges in increasing crop yields has been demonstrated in the field. This effect is undoubtedly due to water conservation but we have no knowledge of the amounts of water involved.

Work so far has been concerned with the nitrate status of the soil. Nitrate determinations were made in May on soils from two experiments under cotton in which compost (C) at 6 tons per acre, triple superphosphate (P) at 150 lb. per acre and sulphate of ammonia (N) at 175 lb. and 250 lb. per acre were being tested. In one experiment Nyashimba, Trial (26), the compost and phosphate were applied to the 1952-3 crop, and in the other experiment, Ngereja, Trial (9), these treatments were applied to the 1953-54 crop. In each experiment sulphate of ammonia was applied as a top dressing to the crop in 1954.

At the time of sampling the plants were flowering freely and many bolls had been set. Samples were taken in units of 6 inches. In Trial (9) 6 samples between 0 and 60 inches were taken, alternate samples below 12 inches being rejected. Mean values (in ppm. No_3—N in air dry soil) of the six depth samples from each treatment are presented below.

I. Trial (26), mean of 6 samples, 0-36", NO_3-N, ppm. in air dry soil

	—	P	C	CP
—	0·9	0·8	0·7	0·7
N	11·1	2·8	6·3	2·8

II. Trial (9), mean of 6 samples, 0-60", NO_3-N, ppm. in air dry soil

	—	P	C	CP
—	0·8	0·5	0·4	0·5
N	3·7	2·3	2·5	1·2

The figures presented show how the presence of both phosphate and compost increase the plants' demand for nitrate as indicated by a reduction in the soil nitrate status. There appears to be a limit of about $\frac{1}{2}$ ppm. N below which the plant cannot remove nitrate from the soil, and that in the absence of phosphate or compost the added nitrogen was in excess of the plants' requirements. At Namulonge similar results have been obtained but the soil nitrate values are generally higher than at Ukiriguru.

In Trial (26) plots which had received sulphate of ammonia in 1953 were analyzed. These were found to contain no more nitrate than plots which had received no sulphate of ammonia. This supports the results of field experiments which generally show no residual effect of sulphate of ammonia.

pH determinations on samples from Trial (26) showed a drop from 6·0 to 5·5 in the 0-6 inch layer due to the addition of sulphate of ammonia. There was no effect in the 24-30 inch layer. Plots which had received sulphate of ammonia in the previous year gave a pH of 6·0 suggesting that the acidifying effects of sulphate of ammonia are temporary.

In Trial (9) the reduction in pH due to sulphate of ammonia was from 6·4 to 5·6 in the surface, and from 6·5 to 6·0 at 60 inches.

Appendix.

Origin and Special Characteristics of the Main Cotton Strains Mentioned.

Lake Province "Local"	The commercial cotton in the Province prior to the issue of Mz561—mainly of Uganda Local origin.
Mz561	A straight selection from "Local", first multiplied in the 1939-40 season.
Uk46	A seed issue with fair jassid resistance, made up of the four best Ukiriguru strains and the three best Lubaga strains available at the time, first multiplied in the 1946-47 season.
Uk48	A seed issue made up of four strains of better jassid resistance than Uk46, first multiplied in the 1948-49 season.
Uk51	A seed issue made up of seven strains with jassid resistance, first multiplied in the 1951-52 season.
Uk53	A seed issue made up of eleven strains, first multiplied in the 1953-54 season.
5/57	A derivative of 3/17, itself a straight selection from "Local".
6/318	Ex 4/35, itself a derivative of Mz561.
7/150	Ex 3/28, having high jassid resistance.
7/367	Ex Lubaga L.4/112, ex originally Mz457.
8/290	Ex 6/320, one of the heaviest cropping Ukiriguru strains.
1/686	Ex Barberton U4 × Sea Island.
Albar 51	General term for 1951 selections from Nigerian Allen, highly resistant to bacterial blight; ex Dr. J. B. Hutchinson.

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